The Mummified Seals of the Dry Valleys: a Literature Review

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Introduction

By the accounts of most who visit them the Dry Valleys of southern Victoria Land, on the shores of the Ross Sea, exert a strange fascination. Left literally high and dry by receding glaciers, these “oases in the ice” (Clarke) are starkly beautiful. They are of unusual scientific interest too: stripped of the ice mantle up to 4km deep which covers most of Antarctica, they provide a rare opportunity to study the continent’s geology, flora and fauna.

But not all of the secrets of the Dry Valleys are readily revealed. From the first years of Antarctic exploration observers were puzzled to find the contorted and mummified carcases of seals many kilometres up the valleys and in surrounding areas, often at considerable heights above sea level. What drove the seals to trek doggedly away from their colonies and food sources until they apparently starved to death remained a mystery: theories from tidal waves to climate change, glacial retreat or suicide were put forward, but none seemed satisfactlory.

Also mysterious was the age of the carcases. Early efforts at carbon dating suggested some of the seal remains were up to 2600 years old, but the inaccuracy of carbon-dating marine creatures in Antarctica makes these results unreliable. A more recent theory is that the harsh conditions prevailing in the Dry Valleys obliterate bone and tissue quickly, and that even the most weathered of the carcases are only a few decades old (Dort 1981).

Other questions abound. Most of the seal carcases are Crabeater seals (*Lobodon carcinophaguis*), yet the dominant seal in McMurdo Sound, where they appear to have come from, is the Weddell (*Leptonychotes weddellii*). The seals demonstrate a puzzling determination to march to their deaths: faint tracks from one seal found dead on the surface of Lake Bonney (Dort 1981) ran for several kilometres in an almost straight line, and a live animal heading inland across the McMurdo Ice Shelf resisted all attempts to point it back towards the sea (Stirling and Kooyman). This has led to speculation that these unfortunate animals are following some sort of internal guidance system which has gone wrong (Dort 1981).

After a flurry of activity studying the seals in the sixties and seventies, little work appears to have been done since. Some study is currently focused on the microbial colonies beneath the dead seals, which apparently differ greatly from one carcase to another. Dr Craig Cary of Waikato University is shortly to publish on this topic.

This paper will attempt to follow the trail of the seals, as it were, from the earliest observations by Scott and Shackleton’s parties to the most recent – and still inconclusive - theories about how and why they met their strange deaths.

Fig. 1. A mummified seal carcase in the Taylor Valley (picture by Chris Gardner)

The Early Days

One of the first sightings of mummified seal carcases was recorded by Dr. Wilson, in Scott's 1905 *Voyage of the Discovery*. The Dry Valleys had not yet been visited, and these particular remains were found in the glaciers of the Royal Society range. Wilson records that "Old seals near the point of death retire to the most secluded spots. It was not therefore unaccountable to find the remains of dead seals many miles from the actual coast, and high up on the biggest glaciers… not one but several were found by Armitage at a height of 2000 feet and between twenty and thirty miles from the actual coast" (Wilson in Scott).

Wilson's usual scientific curiosity seems to have failed him at this point: perhaps he simply had too many other things to consider to ask himself why these seals, so cumbersome on land, would lumber far from their habitats on journeys apparently certain to end in death. At any rate, he was content to dismiss the finds as evidence of normal seal behaviour. He may even have had in mind a comparison with the supposed behaviour of elderly elephants, commonly thought at the time to retreat to an "elephants' graveyard" when near death. In fact, this theory was flawed: as will be seen later most of the dead seals appear to have been young pups and not adults at the end of their lives.

Only a few years later Raymond Priestley, a scientist on Shackleton's Nimrod expedition, noted three mummified Crabeater seal carcases between 2000' and 3000' in the Ferrar Glacier Valley. He also recorded that the moraines in the region were "covered with scattered remains". No further attention is given to the phenomenon: Priestley was a geologist and not a zoologist, and went on give much information about the physical features of the valley.

The 50s and 60: interest increases

The trail then goes cold for some 50 years before scientific interest is renewed in the seal carcases, this time in the Dry Valleys north of Priestley and Wilson's explorations. In 1957-58 the American Troy Péwé and two colleagues found 90 mummified seals throughout the ice-free areas of the McMurdo Sound region.

Péwé noted that the age of the carcases was "intriguing": upon inspection the remains were initially thought to have been perhaps 100 years old, "because the arid and cold climate of the area is ideal for retarding organic decay". However carbon-dating of one of the most weathered carcases suggested an age of between 1600 and 2600 years. This was *after* allowance was made for the relatively low level of radiocarbon found in upwelling waters in the Antarctic, which severely affects the accuracy of carbon-dating both marine creatures and those which feed on them. (This produces odd results: a freshly-killed Antarctic seal was once carbon-dated at 1300 years (Dort 1981)).

At about the same time G. C. Claridge found some 20 carcases in the Taylor Dry Valley. On the assumption that they were roughly the same age as the seals carbon-dated by Péwé he calculated that seals entered the valley roughly every hundred years; though he also noted tracks made by some of the seals, which caused him to wonder if the carcases were not perhaps more recent.

Also in 1958 Graeme Caughley of the New Zealand Forest Service observed 28 crabeater seal carcases in the Taylor Dry Valley at Lake Bonney, fifteen miles from the sea. Caughley noted that the seals appeared to be young: none had reached the length associated with sexual maturity, and the ends of their flipper bones had not fused to the shafts, another sign of youth.

Over the summer seasons of 1957-59, 58-59 and 59-60 three small expeditions from Wellington's Victoria University entered the Dry Valley area bounded on the north by the Miller, Cotton and Debenham Glaciers and on the south by the Taylor Glacier. Some 2500 square miles of new territory was investigated, and a variety of geological and geophysical studies were carried out. Biologists Ron Balham and Dick Barwick, on separate expeditions, discovered the largest haul yet of mummified seals: 121 carcases were noted, up to 40 miles inland and at altitudes of up to 3000 feet. They devised a system categorising the remains according to seven degrees of erosion, from complete and undamaged (only one animal was found in this condition) to minimal remains consisting of miscellaneous fragments. Of 72 seals examined in detail, 35 were identified as Crabeaters and six as Weddells. All the carcases measured proved to be those of

immature animals apparently less than one year old: this conclusion took into account possible shrinkage from the mummification process. The best-preserved carcase had an abdominal fat layer of just 3/16 of an inch, compared to the usual summer layer of some 2 to 2½ inches, reinforcing the theory that the animal had died of starvation.

Balham and Barwick also had two carcases carbon-dated, again allowing for the low levels of radiocarbon in Antarctic waters. The ages indicated were 780 years and 100 years. On the basis of the condition, apparent age and number of seals, they calculated that one seal continued to enter the valleys and die of starvation every four to eight years, quite a different conclusion from Claridge's (above).

Throughout the 60s there were numerous sightings of the seal carcases in the Dry Valleys, though there was little study of the phenomenon. Among those who did study the seals were Ian Stirling and G. L. Kooyman, who observed them "as opportunity permitted" during the seven austral summers from 1962-63 to 1968-69. The pair observed large numbers of Crabeater seals, and again concluded from their size that all were juvenile. They also observed young Crabeaters using Weddell seal breathing holes in the sea ice. This led them to a theory of why some seals headed inland to die, which is discussed below.

Another important name is Wakefield Dort, from the University of Kansas, who has published extensively on the subject of the mummified seals. During the summers of 1965-66, 1966-67 and 1969-70 Dort spent much time studying the carcases. He developed theories about why the seals travelled inland, and the age of the carcases, which are perhaps the most convincing to date: these, again, are discussed below. Dort is among many to note that the majority of seal carcases can be identified by their distinctive krill-straining teeth, described by Dr Wilson almost 100 years ago: "[the teeth] are surmounted by perhaps the most complicated arrangement of cusps found in any living mammal… the cusps form a perfect sieve… a hitherto unparalleled function for the teeth of a mammal" (Wilson, in Cherry-Garrard).

Recently there appears to have been little written about the preserved seals of the Dry Valleys. Dr Rod Seppelt of the old Antarctic Division and Dr Allan Green of the University of Waikato reported in 1990 that they had found the carcase of a tagged Weddell seal near the terminus of the Canada Glacier, in the lower Taylor Valley. This was significant as it gave a far more precise indication of the date of death than had previously been possible. The seal, a female, had been tagged as a pup in November-December 1985 off Turk's Head, Ross Island. The length of its corpse indicated it was about three years old at time of death. It also appeared to have been attacked by skuas, "contrary to belief that skuas do not attack dead seals".

Interestingly, Seppelt and Green also reported a discovery by the South Africans Harris and Watkins of a mummified carcase, tentatively identified as that of a Crabeater seal, found 240 km inland and at 1200m altitude on Tvora in West Dronning Maude Land. If an accurate report, this would appear to set a new record both for distance from the sea and altitude. It is certainly an extraordinary distance for an animal clumsy on land to

travel, presumably without food, and demonstrates if nothing else a great singularity of purpose.

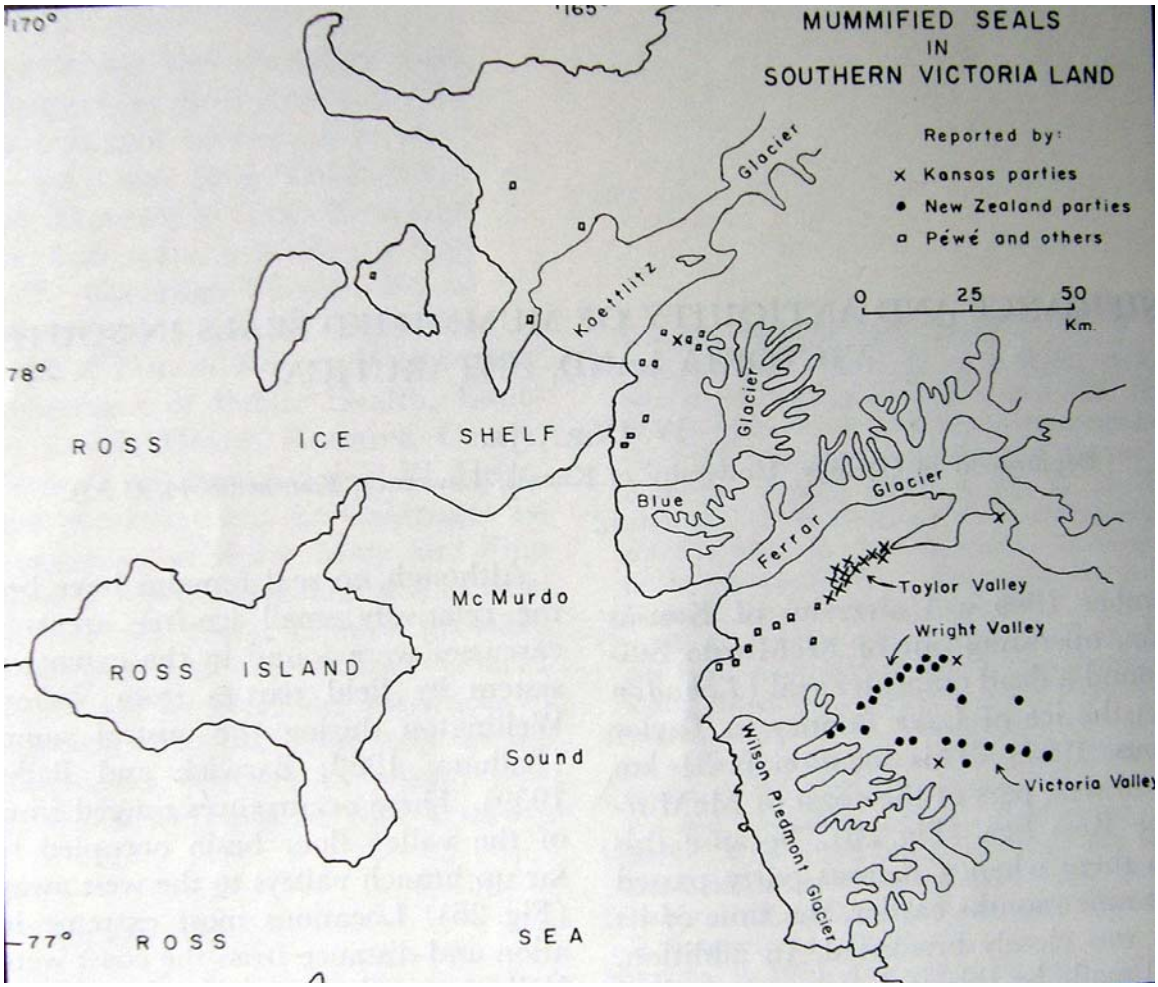

Figure 2: Location of mummified seals in Dry Valleys. From Dort, 1972

Discussion

Which brings us to a question which has been the subject of lively discussion ever since the seal carcases were first discovered: what drives these animals on their unswerving journeys towards what must be a miserable death from starvation and exhaustion?

The theories have been many. Victoria University's Bob Clark refers to the seals' "apparently suicidal migration", though he does not seem to regard suicide as a serious possibility. Clark goes on to note that "suggestions that the carcases are those of anti-social individuals who turned their backs on their fellows – and the coast – have been made. It is considered more likely, however, that the seals simply got lost".

Ron Balham and Dick Barwick were also of the opinion that there was nothing particularly noteworthy about the reasons for the seals' journeys. They note that

Crabeater seals pup in the early spring, September to October, well out in the pack-ice far from the coast, and quote the evidence of Bertram (1940) that the young seals migrate inshore from the pack-ice to the clear waters about the coast in summer. The seals return to the pack ice as winter sets in. Balham and Barwick conclude that "some of the immature seals fail to join the general northward migration in autumn; the random dispersal of these non-oriented young, combined with the directive effects of major land features, results in the entry of the seals into the dry valley systems. Death through starvation ensures, and since the seal carcases are not buried by snow or ice they mummify".

The reference to land features makes the point that the valley systems can act as a "funnel", directing the seals further and further from the water.

Balham and Barwick were unconvinced by the theory of the Russian Evteev, who suggested in 1962 that the seal corpses dated from an earlier age when the Dry Valleys were covered in ice, and that they had been deposited when the glaciers retreated.

This scepticism is shared by Graeme Caughley, who observed several seal carcases on the frozen surface of Lake Bonney, which formed after the retreat of the glaciers. Another carcase was seen lying on top of ripples in the sand, and hence had presumably arrived after the ripples had been formed.

The explanation that the seals had merely become lost, however, seems somehow unsatisfactory, and fails to explain why the animals plod on away from the sea, never turning back. Stirling and Kooyman made observations which go some way towards an explanation. They found a Crabeater pup 2.5 km from the sea and moving inland across the McMurdo Ice Shelf, and whenever they attempted to turn it towards the sea it attacked them (Crabeaters are notoriously bad-tempered animals) and continued south. A Weddell seal moving south through the hills at Cape Evans was captured and released facing east: it also immediately turned around to head south again. It appears there is something in at least some seals which causes them to fixate on a particular – and perhaps fatal – course.

Stirling and Kooyman offer no explanation for this "rigid but aberrant orientation, often in the presence of visual corrective clues" such as the presence of water or other seals. They do however propose a theory for why the seals begin their inland journeys. As previously noted, Crabeater seals are thought to be born on the pack-ice and migrate inshore to clear waters around the coast as the sea-ice melts. The suggestion is that some are trapped inshore when the sea-ice freezes over again. As crabeaters are unable to make breathing holes in the ice this gives them two choices: either to share the holes kept open by Weddell seals, an interesting example of inter-species tolerance observed by Stirling and Kooyman, or to strike out in search of the pack ice. Those animals which set off in the right direction are presumably successful (the distance to the pack ice is less than that of some of the seals' journeys up the Dry Valleys). Those which are disorientated, or unlucky enough to choose the wrong direction, die. This theory also explains why carcases are found in areas other than the Dry Valleys, such as the adjacent Ferrier

Glacier Valley. Large numbers may be found in the Dry Valleys simply because these areas are relatively often-visited, and because those animals which went into snow-covered areas would be buried and not easily found.

Stirling and Kooyman also offer convincing explanations for the high proportion of Crabeater carcases found in the Dry Valleys (some 95% of those identified), even though Weddell seals are by far the dominant species in the McMurdo Sound area. The Crabeaters are the most abundant non-resident visitor to the Sound. Furthermore, they are regarded as far more agile on ice or land than other seal species, and are described as having a distinctive and rapid "undulating" gait: this enables them to travel further on land, ultimately of course to their disadvantage when it comes to the fatal journeys up the Dry Valleys.

Stirling and Kooyman's theory about seals trapped by the ice seems compelling at first glance. However it is disputed by Dort on two counts. Firstly, the sea ice generally freezes from the land or ice shelf outwards, which would tend to lead the seals out to sea rather than trap them. Secondly, most of the carcases found in the Dry Valleys appear to be of very young seals, many apparently in the first weeks of life. If they did not begin to make their way inland until the sea ice began to freeze they would be older and larger.

Dort proposes another theory: occasionally there is a mild winter and an early spring and the sea ice melts early. This gives very young seals access to land earlier than would normally be the case. Some may begin to wander – perhaps because they are abandoned by their parents or orphaned. Those which travel too far inland without retracing their steps eventually die.

Dort also suggests a reason for the apparently single-mindedness of these young animals in faithfully following their chosen course. In the first few days of life some of them may have been taken on journeys by their mothers across the pack-ice towards the still-frozen sea-ice. If the mother then disappears for whatever reason the direction of this early journey may be "imprinted" on the baby seal, which continues doggedly on its course "still searching for parental companionship or food", and ignoring its fellow seals which remain in more life-sustaining surroundings.

There is another area where Dort challenges previous theories: the age of the carcases. As had been noted above, carbon-dating results in Antarctic waters are notoriously unreliable. Attempting to allow for the uncertainties, carbon-dated ages of between 100 and 2600 years have been obtained for various seals. Péwé concluded that "the cold arid climate preserves their carcasses an incredible length of time, and the remains of seals and other animals that have wandered inland during the last 2000 years probably still exist to attest the animals' last journey".

Dort, on the other hand, suggests that the conditions in the Dry Valleys are so harsh that no organic material could possibly last for long there. The well-preserved seals are likely to be only a few years old, and the well-mummified carcases may be only 20 or 30 years old. As for the skeletal remains, "it does not seem reasonable that such remains, lying

unprotected on the surface of the bare ground, could long withstand the combined destructive effects of buffeting by high-velocity winds, abrasion by windblown ice crystals and sand grains, frost fracture, salt weathering, and chemical breakdown by moisture from melting snow."

These processes, Dort reminds us, can scour out solid rock. His words are also a reminder of the remarkably unforgiving conditions in which these seals met their unpleasant, and mysterious, ends.

Conclusion

Much about the mummified seals remains unknown. Recent research refers to them as "anomalies" preserved "for an undetermined length of time" (Robson). Their reasons for embarking on the long fatal journey away from the water is similarly unknown, though some interesting theories have been put forward and are discussed in this paper.

Few scientists now appear to be interested in exploring these questions. However work is currently being done on the surprisingly varied nature of the microbial communities found under different carcases (*ibid*).

Thus, though the seals have yet to give up the secrets of their deaths, they are now providing other information which may prove useful in future.

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